DESIGN CRITERIA
FOR PUBLIC IMPROVEMENT PROJECTS

CITY OF GARDNER, KANSAS

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PROCEDURE FOR

PUBLIC IMPROVEMENT PROJECT PLAN SUBMITTAL

A. General. All developers and engineering consultants submitting plans for public improvement projects to the city for review are required to follow the procedures outlined in this section. No public improvement projects may be constructed in the City of Gardner without prior approval of the Engineering Division.

The majority of all public improvement projects are funded by either private developer, benefit district, or the city at large. The procedure to follow and the amount of time involved in approving plans is dependent on the source of funding for the project.

B. Public Improvements. The plan review process is as follows:

1. The first submittal should contain two sets of plans. This and all subsequent submittals are dated and recorded in a project status log.

2. The normal time for review of the first submittal is 15-20 working days. In the case of abnormally large sets of plans (greater than 20 sheets) or of extremely complicated drawings, a longer time may be required for review. Additionally, review time is also dependent upon the number of plans that have already been submitted for review.

3. The plans will be routed through the appropriate city departments and/or divisions to obtain a complete review of all facilities which may be affected by the construction. They will also be reviewed to confirm conformance with city standards and design criteria. Upon completion of city review, a written set of comments will be submitted to the design engineer.

4. The consultant will be required to make all necessary corrections and/or revisions as noted in the written comments. Upon completion of the corrections and/or revisions the consultant shall submit two new sets of plans to the Engineering Division and written responses to comments. Review time is approximately 10-15 working days.

5. The third and any subsequent submittals shall contain all necessary revisions, as well as written responses to comments. If the plans are close to approval, the final plat showing all proposed easements should be submitted, as well as any necessary application forms such as Kansas Department of Health and Environment sewer and water extension permit, Kansas Department of Transportation permits, Department of Agriculture channel change permit, etc.

6. Once a submittal is approved, the City Engineer will verify that all necessary state permits are obtained and all plats and easements are filed. Five full size and one half size plan sets shall be submitted to the city for signature. Additionally, one copy of the electric layout plan sheet and one electronic copy of the plans in Autocadd shall be submitted to the City of Gardner. The Engineering Division will notify the engineer once the plans have been signed and will provide one copy of the plans for their use. Additionally, two copies of the

plans will be provided to the contractor once inspection fees are paid and bonds and bid estimates are submitted. The contractor will be required to sign a permit for construction which authorizes the contractor to begin work. A brief preconstruction meeting will be required to be attended by the contractor to discuss specific project issues prior to beginning site work.

7. Public improvement plans and engineering reports are approved initially for one year after the date signed on the cover sheet next to the city engineer's signature. After one year, the plans or report shall become null and void and must be re-submitted prior to approval of construction of that project. Such plans and/or reports shall be re-submitted to the Engineering office in accordance with the foregoing outlined procedure and requirements.

GENERAL PLAN REQUIREMENTS FOR

PUBLIC IMPROVEMENT PROJECTS

DC1-001 GENERAL. All plans and reports submitted shall be prepared by, or under the direction of and sealed by a professional engineer licensed in the state of Kansas, and shall be reviewed by the city for compliance with the minimum design requirements as established in the Design Criteria Manual for Public Improvement Projects of the City of Gardner and with all other applicable city codes and standards.

Attention is directed to the design engineer that whenever extraordinary or unusual problems are encountered in conjunction with a proposed project, additional information and analysis beyond the minimum requirements of these standards and criteria will be required.

The City of Gardner is not responsible for the accuracy and the adequacy of the design or dimensions and elevations as depicted on the plans (which shall be confirmed and correlated at the site of the work). The City of Gardner, through the approval of the plans and/or report, assumes no responsibility for the completeness and/or accuracy of the public improvement plan or report.

DC1-002 REQUIRED NOTES. The following general notes will be required as a minimum on all plan submittals for public improvement projects. These notes are not meant to be all-inclusive, and in certain situations the use of additional notes may be required by the City Engineer.

A. Development plans and stormwater management studies are approved initially for one (1) year after which they automatically become void and must be updated and re-approved by the City Engineer before any construction will be permitted.

B. The City of Gardner plan review is only for general conformance with City of Gardner design criteria and the city code. The city is not responsible for the accuracy and adequacy of the design, or dimensions and elevations which shall be confirmed and correlated at the job site. The City of Gardner, through approval of this document, assumes no responsibility other than that stated above for the completeness and/or accuracy of this document.

C. The contractor shall have one (1) signed copy of the plans (approved by the City of Gardner) on the title sheet and one (1) copy of the appropriate Design and Construction Standards and Specifications at the job site at all times.

D. Construction of the improvements shown or implied by this set of drawings shall not be initiated or any part thereof undertaken until the City Engineer is notified of such intent, and all required and properly executed bonds and contract agreements are received and approved by the City Engineer.

E. The City of Gardner technical specifications, latest edition, shall govern construction of this project.

F. All existing utilities indicated on the drawings are according to the best information available to the engineer; however, all utilities actually existing may not be shown. Utilities damaged through the negligence of the contractor to obtain the location of same shall be repaired or replaced by the contractor at his expense.

G. All backfill shall be tamped. Backfill within the right-of-way shall be to 95 percent (95%) compaction at optimum moisture.

H. All excavation beneath streets shall be backfilled with CA-5 rock to four feet (4') back of curb. If cover over pipe is less than 2 feet, use CA-5 to 6" above top of pipe, then removable flowable fill to bottom of asphalt pavement.

I. Contractor shall not be allowed to work on Sundays. Holiday or Saturday work shall be as approved by the City Engineer.

J. All water required for the construction of this project shall be purchased from the city Utilities Department through the use of a fire hydrant water meter. Meters can be obtained from the Utilities Department for a nominal deposit, refundable upon the return of the meter.

K. Relocation of any water line, sewer line or service line thereof required for the construction of this project shall be the responsibility of the contractor at his expense.

L. The contractor shall install 12 gauge copper wire along all water lines that are not ductile iron pipe to facilitate underground marking and location. Connection shall be made to all valve risers as a minimum, whereas other connection points such as hydrants, flushing assemblies, existing line ends or meter pits may occasionally be required. Splicing shall be held to a minimum and will not be allowed between valve risers. Split bolt connectors or service connectors shall be used to splice points to properly connect and maintain electric continuity throughout the system. Before project acceptance, the city will test the electric continuity of all installations at no cost to the contractor.

M. All sanitary sewer stublines shall be laid on 1.00% grade unless approved otherwise. If necessary, risers shall be installed so that stubs are no deeper than 8 feet below final grade.

N. Manholes, junction boxes, and valves shall be placed outside of all pavement and proposed and future sidewalks.

O. The contractor shall install and properly maintain a mechanical plug at all connection points with existing sanitary sewer lines until such time that the new line is tested and approved.

P. To prevent damage to main sewer lines, all blasting required for laterals stub lines shall be performed during blasting for the main line.

Q. A pre-blast survey shall be submitted to and approved by Public Safety prior to the initiation of blasting operations.

R. All sidewalks shown are for information purposes only unless specifically noted in the plans. Sidewalks shall not be built as a part of this project; however, contractor shall be responsible for sidewalk ramp construction. All existing sidewalks shall be maintained and remain open to pedestrian traffic when possible. If sidewalks are closed, temporary sidewalks may be required as directed by the City Engineer. The duration of closure shall be approved by the City Engineer.

S. A minimum of one (1) compaction test and a maximum of two (2) compaction tests shall be performed by a qualified testing laboratory for every 1000 feet of street construction. Soil samples for such tests shall be collected by laboratory technicians. All testing laboratory expenses shall be paid for by the contractor.

T. If precast concrete storm sewer structures are to be used on this project, the contractor shall, subsequent to review by the design engineer, submit shop drawings and have them approved by the city engineer prior to fabrication of the structures. Failure to do so shall be cause for rejection.

U. Monument boxes conforming to Standard Detail 13-5 shall be installed at all quarter section corners as involved in the street construction. All monuments disturbed or removed during construction shall be replaced by the contractor at his expense.

V. Where a new street is to connect to an existing street, all deteriorated or cracked asphalt within five feet (5') of the connection point shall be removed to a depth where sound material is found. If full depth pavement removal is required, the subgrade shall be recompacted to 95 percent (95%) of standard maximum density. All connections to existing streets shall be neatly saw cut to full depth.

W. Erosion control measures will be required to be installed prior to any grading or construction activities.

X. All projects which disturb a cumulative area of more than one acre will be temporarily seeded and mulched to the requirements of Section "7200 Seeding and Sodding" immediately after street construction (paving) is complete**.** Regardless of cumulative area, established yards shall be revegetated with the same vegetation if disturbed during construction. It is the responsibility of the contractor to notify property owners 48 hours in advance prior to performing any activities that will alter their yard.

Y. No open cut of streets is allowed unless approved by the City Engineer. A traffic plan prepared per MUTCD guidelines shall be submitted and approved by the City Engineer prior to construction. Unless otherwise approved by the City Engineer, one lane shall be open at all times or flashing sign boards posted a minimum of 5 days prior to construction.

Z. Steel fence T-posts (6') are required at all manholes, clean outs, valves, hydrants, and flushing assemblies until development occurs.

AA. Proof-rolling of the road base is required prior to placement of concrete curb and gutter or asphaltic street paving materials. The contractor shall proof-roll the subgrade with a fully loaded tandem axle dump truck, while being observed by the city's representative. All soft or spongy areas shall be dug out, recompacted and proof rolled again until the city's representative is satisfied that the subgrade is stable.

DC1-003 APPROVAL BLOCK. A signature block shall be required on the cover sheet of all plans or reports submitted for review and approval. All plans require the signature of the City Engineer and the date of such signing for formal approval by the city.

The general form of the approval block shall be as follows:

APPROVED

_____ _____

City Engineer Date

APPROVED FOR ONE YEAR FROM THIS DATE

DC1-004 PRIVATE IMPROVEMENTS. Private improvements, if any, shown on public improvement plans, shall be clearly defined and marked as such. These improvements will not be maintained by the City of Gardner and, as such, an appropriate note shall be included on the drawings. These improvements nonetheless shall be designed and constructed to city standards.

DESIGN CRITERIA FOR

SANITARY SEWERS AND APPURTENANCES

DC2-001 DESIGN FACTORS. Sanitary sewers shall be designed for the ultimate tributary population. Due consideration should be given to current zoning regulations and approved planning and zoning reports where applicable. Sewer capacities shall be adequate to handle the anticipated maximum hourly quantities of sewerage and industrial waste together with reasonable consideration given to infiltration/inflow.

DC2-002 SEWER DESIGN. Sewers shall be designed for the total tributary area using the following minimum criteria:

The table below should be used to establish the Peak Flow for a project. Low density residential shall be considered as up to and including 3.5 residences/acre. Above that value will be considered high density residential. Extrapolations to determine the Peak Flow/Acre may be made for the specific size of the development (acres).

Peak Flows for Design

Area	Residential		Commercial / Industrial
	High Density	Low Density	
(acres)	(cfs/acre)	(cfs/acre)	(cfs/acre)
Up to 100	0.022	0.019	0.0175
200	0.021	0.018	0.0165
500	0.017	0.014	0.0125
1000	0.014	0.0118	0.01
1500	0.0135	0.0108	0.009
2000	0.013	0.01	0.008

Peak Flows can be increased by outside circumstances, such as other watershed contributions flowing by gravity or being pumped into the design watershed. If this is the case, the system design shall include these external factors.

Using this criteria, interceptor or main sewers and relief interceptor sewers 18-inch and larger pipes are to be sized flowing **three-fourths** full; up to 18-inch pipes are to be sized flowing **two-thirds** full. Lateral sewers may be designed to flow at capacity. All sewers are to be designed for anticipated flows from a 50-year return interval storm. Design calculations for proposed pipe, as well as existing pipe the proposed pipe will tie into, shall be included in the plans or provided as a separate submittal. In addition to the design calculations, a map must be included which shows the entire tributary area.

DC2-003 MAXIMUM SIZE. The diameter of sewers proposed shall not exceed the diameter of the existing or proposed outlet, whichever is applicable.

DC2-004 MINIMUM SIZE. No public sewer shall be less than eight inches (8") in diameter. Stublines for service connections shall not be less than six inches (6") in diameter.

DC2-005 MATERIALS OF CONSTRUCTION. Sanitary sewers shall be constructed of pipe material resistant to or protected from bacterial degradation, acid and alkaline solutions, normal sewer temperature variation, abrasion, and industrial wastes or other materials which may be transmitted by the collection system.

The following types of commercial pipe are approved for gravity sanitary sewer systems constructed in the City of Gardner:

*PVC Pipe
*Reinforced Concrete Pipe
*Ductile Iron Pipe

* See Standard Specifications Section 3000 for material and lining specifications.

For PVC pipe, PVC SDR-35 shall be used for depth to invert up to 15 feet and PVC SDR-26 used for depths greater than 15 feet.

DC2-006 MINIMUM SLOPE. All sewers shall be designed to give mean velocities when flowing one-half full of not less than 2.0 feet per second.

All velocity and flow calculations shall be based on the Manning Formula using an N value of 0.013. The following slopes shall be minimum for the size indicated.

	MINIMUM SLOPE IN PERCENT
SEWER SIZE	FULL AND HALF FULL FLOW
8"	0.40
10"	0.28
12"	0.22
15"	0.15
18"	0.12
21"	0.10
24"	0.08
27"	0.065
30"	0.058

Exceptions to these minimum slopes shall be made at the upper end of the lateral sewers serving under 30 houses. Said sewers shall have a minimum slope of 0.76 percent. All sewers larger than 30 inches in diameter shall have the slope approved by the city engineer.

Where lateral sewers serve less than 10 houses, the minimum slope shall not be less than 1 percent (1%).

DC2-007 INCREASING PIPE SIZE. When a sewer joins a larger one, the invert of the larger sewer should be lowered sufficiently to maintain a continuous energy gradient.

DC2-008 HIGH VELOCITY PROTECTION. In situations where flow is continuous and grit is a problem, or where velocities greater than 10 feet per second are possible, special provisions shall be made to protect against abrasion damage to the pipe and manhole. Such protection may be attained utilizing ductile iron pipe.

DC2-009 ALIGNMENT. All sewers shall be laid with straight alignment between manholes. The interior angle between incoming and outgoing lines for both existing and new mains shall be clearly labeled at all manholes in the plan view in degrees, minutes, and seconds at each manhole. Interior angles less than 90 degrees shall not be accepted.

DC2-010 MANHOLE CONSTRUCTION. Manholes shall be installed at the end of each line; at all changes in grade, size, or alignment; at all intersections; and at a distance not greater than four hundred feet (400') for sewers eighteen inches (18") or less in diameter and not greater than six hundred feet (600') for larger sewers.

DC2-011 MANHOLES. The construction of all manholes shall conform to the details shown on Standard Details 31-1 through 31-4. A standard manhole shall be four feet in diameter for depths up to 20 feet deep, 5 feet diameter for depths 20 to 25 feet deep and/or pipes entering and exiting the manhole with diameter 24 inches to 30 inches, and 6 feet diameter for depths over 25 feet deep and/or pipes entering and exiting the manhole with diameter greater than 30 inches. All manholes over 20 feet deep must be approved by the City Engineer.

Drop manholes should be avoided as much as possible. However, an outside drop pipe shall be provided for a sewer entering a manhole at an elevation of twenty-four (24) inches or more above the manhole invert. The outside drop pipe shall be protected against breaking or settling by the use of concrete encasement. When PVC pipe is used for the drop pipe, gravel may be substituted for the concrete encasement around the drop pipe and fittings. The drop pipe shall have the same nominal diameter as that of the incoming sewer.

Without utilizing drop manholes, the difference in elevation between the invert of any incoming sewer and the invert of the outgoing sewer should not exceed twenty-four (24) inches except where required to match crowns. When a sewer joins a larger one, the crown of the smaller sewer shall not be lower than the crown of the larger one. The minimum drop through manholes shall be 0.2 feet for manholes with greater than 45^{o} turns and 0.1 feet for straight-through trough and up to 45^{o} turns.

Where manholes are to be built in close proximity to streets, the top of manhole elevation shall be set within the following limits:

Minimum Elevation	1/4" per foot rise above top back of curb
Maximum Elevation	1/2" per foot rise above top back of curb

All other sanitary sewer lines (sewer lines across unplatted land, etc.) shall have the tops of manholes set flush with the existing ground elevation except for manholes located within

the floodplain. The top of all manholes located in a floodplain shall be 1.0 foot above the 100-year floodplain and shall be constructed with bolt-down lids.

Any variation from the above top of manhole criteria will require a letter of explanation to be submitted with the drawings and be subject to approval by the city engineer.

DC2-012 SEWER LOCATIONS. Sanitary sewers shall be located within street or alley rights-of-way unless topography dictates otherwise. Sanitary sewers should also be located outside of pavement when at all possible. When located in easements on private property, access shall be provided to all manholes. A manhole shall be provided at each street or alley crossing. End lines shall be extended to provide access from street or alley rights-of-way where possible. Imposed loading shall be considered in all locations. Not less than eight feet (8') cover shall be provided over top of pipe in street and alley rights-of-way and five feet (5') in all other areas.

Sanitary sewer mains shall be extended to property lines and a manhole provided at the edge of property lines to accommodate future main extensions.

DC2-013 CLEANOUTS AND LAMPHOLES. Cleanouts and lampholes will not be permitted except on service lines.

DC2-014 PROTECTION OF WATER SUPPLIES. There shall be no physical connection between a public or private potable water supply system and a sewer, or appurtenance thereto, which would permit the passage of any wastewater or polluted water into the potable water supply.

GRAVITY SANITARY SEWERS: When potable water pipes and gravity sanitary sewers are laid parallel to each other, the horizontal distance between them shall be not less than 10 feet. The distance shall be measured from edge to edge. The laying of water pipes and sanitary sewers shall be in separate trenches with undisturbed earth between them. In cases where it is not practical to maintain a 10 ft separation, KDHE will consider proposals providing equivalent protection by other methods on a case-by-case basis, if supported by data from the design engineer. Equivalent protection may require sanitary sewer construction with one of the following additional protective features: concrete encasement, vacuum sewers, or jointless pipe such as polyethylene or cured-in-place.

When a water pipe and a sanitary sewer cross and the sewer is 2 ft or more (clear space) below the water pipe, no special requirements or limitations are provided herein. At all other crossings, the sanitary sewer is to be constructed of one of the following materials (or approved equal) and pressure tested to assure water tightness pursuant to Chapter VI of the KDHE Minimum Standards of Design of Water Pollution Control Facilities.

- Ductile iron pipe conforming to ASTM A536 or ANSI/AWWA C151/A21.51 with minimum thickness class 50, and gasketed, push-on or mechanical joints in conformance with ANSI/AWWA C110/A21.10 or ANSI/AWWA c111/A21.11.

- PVC pipe conforming to ASTM D3034 with minimum wall thickness of SDR41, ASTM F679, ASTM F789, or ASTM F794, with gasketed push-on joints in conformance with ASTM D3212.

- Reinforced concrete pipe conforming to ASTM C76 with gasketed joints in conformance with ASTM C361 or ASTM C443.

Joints in the sewer pipe shall be located as far as practical from the intersected water main.

Where a water main is laid across or through an area where there is an existing sanitary sewer, which is not constructed of one of the above specified materials and is 2 feet or less below the water pipe, the existing sewer shall be encased in concrete with a minimum of six inches thickness for a 10 foot distance on each side of the crossing or the crossed section of sewer replaced to meet the above specified construction requirements. KDHE will consider proposals providing equivalent protection by other means on a case-by-case basis, if supported by data from the design engineer.

Where sanitary sewer lines are to be installed under and across water lines and a two foot (2') clearance cannot be obtained because of limiting grades or grades of existing structures, then the sewer line shall be constructed of ductile iron pipe for a distance of at least ten feet (10') in each direction from the crossing.

DC2-015 SEPARATION FROM OTHER UTILITIES. A minimum of 5 feet horizontal separation shall be provided between the outer wall of sanitary sewer mains and all other utilities (except as noted for water as discussed above in Section DC2-014). In addition, utilities shall not be located in a common trench, but separated by a minimum of 3' undisturbed earth. The separation between the outside walls of sanitary sewers and all other utilities that are within 10 feet of each other must be labeled on the plans.

DC2-016 AERIAL CROSSINGS. Adequate support shall be provided at all joints in pipes utilized for aerial crossings. All aerial crossings shall be approved by the city engineer.

DC2-017 UNSEWERED DWELLINGS. All existing addresses that will be provided access to the sewer that previously did not have sewer service available shall be identified. This identification shall include the approximate distance from the dwelling to the sewer.

DC2-018 MAXIMUM SLOPE. All sewers which are designed to flow at 10 feet per second or greater shall be reviewed by the city engineer for approval or alternate design considerations. Concrete collars for steep slopes shall be proposed when pipe slopes are 10% or greater.

DC2-019 STUB LINES. Stub lines will not be permitted in manholes except for manholes at the end of a line. Stub lines will be provided for all service lines requiring street crossings. Service lines for properties not requiring street crossings will be tapped at the time of building construction. If necessary, risers shall be installed so that stubs are no deeper than 8 feet below ground surface.

Stub lines shall be constructed no closer than 10 feet from property lines, but should be placed so that they are not in conflict with existing infrastructure and/or future driveways.

DC2-020 LIFT STATIONS. All lift stations shall be manufactured by Smith and Loveless, Inc. (classic style) and shall be wetwell mounted. The lift station must meet firm pumping capacity and shall be designed in accordance with the design criteria as specified under Sewer Design (Section 5-1, Item B). Any variation from the specified lift station or design must be approved by the city engineer.

DC2-021 LOW PRESSURE FORCE MAIN. Low pressure force mains are not recommended. If a low pressure force main is necessary, the engineer must submit plans and specifications along with a cost/benefit analysis prior to approval. All low pressure force mains must be approved by the city engineer.

DC2-022 EASEMENTS. Permanent easements must be provided for all sanitary sewer mains. Permanent easements for sanitary sewer mains shall be centered on the main. The minimum easement width shall be 15 feet; however, easement widths may be increased depending upon the depth of the sewer main.

DESIGN CRITERIA FOR

STREET IMPROVEMENTS

DC3-001 GENERAL. Proposed street improvements within the city shall conform to the pattern as established in the Gardner Comprehensive Plan as adopted by the governing body of the City of Gardner. The major goal for transportation is to provide a safe and efficient transportation system which facilitates the movement of people and goods within the city.

To this end, street improvements within the City of Gardner shall be designed to conform with all applicable codes, regulations, and ordinances as established by the city. Plans for said improvements shall be submitted to the City Engineer for approvals, and all plans shall include all information as may be required or described hereafter.

DC3-002 FUNCTIONAL CLASSIFICATION OF STREETS. In fulfilling the goal of creating a "safe and efficient transportation system," the city must define geometric design standards for streets and highways which would afford both adequate traffic mobility and suitable access to abutting property. The following paragraphs provide a description of the street system based on functional classes. Typical street cross sections are shown in Section 13 of the Standard Specifications.

Arterial:

Expressway or Freeway: Since its main purpose is to carry through traffic movement, expressways and freeways are properly classified as arterials. However, owning to their unique geometric and access design, they are more appropriately the function of federal or state control. As a result, geometric design shall conform to those criteria defined by state or federal transportation agencies.

Arterial: An arterial shall mean a street or highway that provides for rapid and efficient movement of large volumes of through traffic between sections of the city and across the urbanized area. It is not primarily intended to provide land access service. Therefore, the number of curb cuts on a planned arterial shall be held to a minimum where they can be controlled and adequately protected.

In general, the arterial has full or partial access control, but is not restricted to controlled access facilities. Arterials can be four to six lanes wide, with or without medians, and commonly can be found on the mile section lines of the city. Signalized intersections along arterials should be spaced far enough apart to permit efficient two-way progressive movement of traffic between intersections at the desirable off-peak and peak hour operating speeds.

Collector Street: The collector street provides traffic circulation within residential areas. Land access is a secondary function of the collector. The collector distributes trips from the arterials to the local street network. Collectors penetrate but should not have direct continuity through residential areas.

Operating speeds should be 25 to 30 mph. Since speeds are slower and turning movements are anticipated, closer intersection/access spacings can be used than on arterials. Because land access is a secondary function of collectors, the number of lots fronting onto a collector should be held to a minimum in order to reduce the numbers of driveways, and thus, the number of friction points.

Service Street: The service street provides traffic circulation within commercial and industrial complexes from the arterial street system. Service streets should not have direct continuity with residential areas.

Operating speeds should be 25 to 30 mph. Since speeds are slower and turning movements are anticipated, closer intersection/access spacings can be used than on arterials.

Because service streets facilitate truck-related land uses, the special provisions associated with truck accessibility shall be considered within design. Wider turning radii and turning lanes shall be considered. Service streets shall not be utilized for backing or loading maneuvers. All such trucking maneuvers shall be handled on-site of the adjacent land uses.

Local Street: The major purpose of the local street is to provide direct traffic access to abutting land.

Traffic movement on local streets is incidental and involves traveling to or from a collector facility. Therefore, trip length on the local street is short, and as a result, both traffic volumes and operating speeds are usually low. Generally, through traffic is deliberately discouraged.

A traffic study may be required by the City Engineer as necessary to determine whether additional street improvements and/or turn lanes are required for developments due to proposed traffic volumes.

DC3-003 STREET DESIGN STANDARDS.

	ARTERIALS	COLLECTOR	SERVICE ROADS	LOCAL STREETS
NUMBER OF TRAFFIC LANES	4--6	2—5	2--5	2
WIDTH OF TRAFFIC LANES	12'	12'	12'	12'
LEFT TURN LANES	DOUBLE AT SIGNALS	N/A	N/A	N/A
MINIMUM R/W WIDTH (FT)*	120 FT	60 FT	60 FT	50 FT
DESIGN VOLUME (VPD) RANGE	12,000--42,000	1,500--12,000	1,500--12,000	LESS THAN 1,500
MINIMUM DESIGN SPEED (MPH)	50 MPH	40 MPH	40 MPH	30 MPH
OPERATING SPEED MPH	45 MPH	35 MPH	35 MPH	25 MPH
STOPPING SIGHT DISTANCE (FT)	400-475 FT	275--325 FT	275--325 FT	200 FT
MINIMUM RADII HORIZONTAL CURVE	750 FT	250 FT	250 FT	200 FT
SIDEWALKS	5 FT BOTH SIDES	4 FT BOTH SIDES	COMM'L: BOTH SIDES 4 FT INDUST: AS REQ'D BY CITY ENGINEER	4 FT BOTH SIDES
ON STREET PARKING	PROHIBITED	PERMITTED	PERMITTED	PERMITTED
MAXIMUM GRADE (PERCENT) **	5%	8%	8%	10%
MINIMUM GRADE**	1%	1%	1%	1%
CURB RADII (FT)	50 FT	30 FT	30 FT	25 FT
MINIMUM SPACING OF SIMILAR ROADWAYS	1 MILE	400 FT	400 FT	300 FT
INTERSECTION *** R-O-W LINE TO NEAR EDGE OF CURB CUT	250 FT	100 FT	150 FT	50 FT MINIMUM 75 FT DESIRABLE

* A minimum 10' U/E is required on both sides of all streets.

** The maximum and minimum grade may be waived only upon written approval of the City Engineer.

*** Curb cuts are not allowed on controlled access routes. For other major arterials, minimum distance to curb cuts shall be 200 feet.

DC3-004 RIGHT-OF-WAY GRADING. Within the limits of the right-of-way, the finished grade shall slope from 1/4-inch vertical to 1 foot horizontal (1/4" vert.:1' horiz.) minimum, to one-half-inch vertical to one foot horizontal (1/2" vert.:1' horiz.) maximum measured above the back of the curb. These gradients may be varied only upon written approval of the City Engineer.

DC3-005 TANGENT LENGTH. The minimum tangent length between reverse curves shall be 50 feet for local streets. No tangent will be required for radii longer than 500 feet. Because the minimum radii requirements for horizontal curves exceed 500 feet, tangents are not required for arterial roads.

DC3-006 OFF-CENTER STREET INTERSECTIONS. Off center street intersections shall be separated by a minimum centerline to centerline dimension of 200 feet.

DC3-007 CONNECTIONS TO EXISTING PAVEMENTS. Where new street construction is to connect to an existing street, a minimum of five feet of the existing pavement is to be removed to subgrade. This subgrade is to be prepared with that of the new improvement and repaved with the new construction. Existing pavement is to be removed at a saw cut for entire width of street from curb face to curb face. If full-depth pavement removal is required, the subgrade shall be re-compacted to 95 percent of standard density.

DC3-008 MINIMUM ANGLE OF INTERSECTION. It is desirable for all intersections to meet at approximately a 90^{o} angle. Skewed intersections should be avoided and in no case should the angle be less than 75^{o}.

DC3-009 SIDEWALKS. Sidewalk construction shall typically follow the requirements in Standard Detail 21-4 thru 21-8. Temporary sidewalks on unimproved streets may be required to facilitate pedestrian ingress/egress. Construction of temporary sidewalks shall be funded by the developer.

DC3-010 STORM DRAINAGE. All storm drainage works constructed in connection with street improvements shall be designed in accordance with the City of Gardner Design Criteria for Storm Sewers and Appurtenances and APWA 5600, latest edition.

DC3-011 CUL-DE-SACS. At locations where streets are to be terminated and a vehicular connection between adjacent streets is not required a cul-de-sac may be permitted. Such cul-de-sac shall be constructed with a length no greater than 800 feet and a minimum radius of 39 feet to the back of the curb.

DC3-012 TEMPORARY TURNAROUNDS. At locations where streets are to be temporarily terminated which will be extended at a later date, and said street extends beyond the intersection of an adjacent street more than three lots, a temporary cul-de-sac shall be constructed with a minimum radius of 35 feet. The temporary cul-de-sac shall be constructed of asphaltic concrete with a minimum depth of six inches. Curb and gutter will not be required. The cul-de-sac shall be constructed within the limits of permanent right-of-way.

DC3-013 MONUMENT BOXES. Monument boxes conforming to Standard Detail 13-5 shall be installed at all quarter section corners as an element of the street construction.

DC3-014 SIGHT DISTANCES.

A. Stopping Sight Distance--Sight distance is the length of roadway ahead visible to the driver. The minimum sight distance available on a roadway should be sufficiently long to enable a vehicle driving at or near the design speed to stop before reaching a stationary object in its path.

Stopping sight distance represents the sum of the brake reaction distance and the braking distance. These distances are measured from the height of the driver's eye to the height of the object (3.50 feet and 0.5 feet above the road surface, respectively). Design controls for stopping sight distances vary slightly for crest vertical curves and sag vertical curves, and are dependent on the algebraic difference in the grades as well as the design speed. Refer to American Association of State Highway and Transportation Officials' (AASHTO) "A Policy on Geometric Design of Highways and Streets", 2001 or latest version for the minimum stopping sight distances to be used in design of roadways.

B. Intersection Sight Distance--Sight distances at intersections vary from stopping sight distance. The intersection sight distance should be sufficient to permit a vehicle on the minor leg of the intersection to cross the traveled way without requiring the approaching through traffic to slow down. To allow this, an area free of visual obstruction is required at every corner of an intersection. This area is known as the sight triangle.

An obstruction to vision shall be defined as an obstacle (i.e., a parked vehicle, a wall or commercial sign, bush or hedge, guardrail or fence, etc.) which forms a restriction to an assumed line of sight measured from the driver's eye height to a target some distance along the cross street.

Every effort shall be made to select intersection locations so that the maximum sight distance is possible. As an element of this, location of intersections shall always consider the grade changes along the adjacent street in terms of possible sight obstructions.

C. Sight triangle requirements vary based on the type of intersecting streets and are summarized in the following table. All measurements are taken from the point of intersection of the extended curb lines of each intersecting street. The values in the table are dependent on the travel speed of the vehicles on the intersecting street and on the typical vehicle which will approach the intersection. The standard assumed height of the driver's eye for a passenger vehicle is 3.75 feet above the roadway surface (6.0 feet above the pavement for a single unit truck or large semi). This relates to the line of sight required to detect an approaching vehicle on the cross street (regarded as a point 4.25 feet above the roadway surface).

Major Road Type	equired Clear Distance (ft)
Arterial	215
Collector	170
Residential	130

All corner lots within the city limits of Gardner shall have a sight triangle free of visual obstructions from a point 20 feet back along the minor leg as measured from the point of intersection of the extended curb lines of each intersecting street to a point that varies with the street type and is stated in table above. Such an area shall be and remain free of visual obstructions higher than three feet (3') and lower than ten feet (10') above the roadway surface.

DC3-015 UNDERDRAIN. In areas that have known subsurface moisture problems, underdrains will be required. They shall be built as shown in Standard Detail 40-11.

If during construction it does becomes apparent that there is a need for underdrain in a location that was not previously designed for underdrain, the City Engineer can require that the consultant submit a revised plan including underdrains that will provide for subsurface drainage. The standard detail is a minimum. Upon approval of the City Engineer, alternate details for increased capacity may be allowed.

DC3-016 OPEN CUTTING OF STREETS. No open cutting of streets for utilities shall be allowed unless approved by the City Engineer. If an open cut is approved by the City Engineer, a traffic plan in accordance with MUTCD guidelines will be required to be submitted and approved prior to construction. One lane shall remain open at all times or flashing signboards provided at appropriate locations informing drivers of detours. The signboards must be placed at the site at least 5 days in advance of construction.

DC3-017 PRIVATE STREETS. All streets and roadways within any development which are classified as "Private Streets" shall conform to the standards and specifications for public streets, as stipulated in the Technical Specifications and Design Criteria for Public Improvement Projects for the City of Gardner.

DC3-018 BICYCLE PEDESTRIAN TRAIL SYSTEM. The design engineer shall contact the Parks and Recreation Department, Public Works, and/or Planning Department to determine whether any portion of the proposed construction will involve the City of Gardner's Trail System. Sidewalks constructed as part of this system shall be 10 feet in width with a 25' wide pedestrian easement. Trail materials shall include asphalt four inches in depth with a six inch crushed rock (AB-3) base underneath.

DESIGN CRITERIA FOR

STORM DRAINAGE FACILITIES

DC4-001 GENERAL. Stormwater design for developments within the City of Gardner shall conform to the criteria provided in APWA Section 5600, latest edition and the criteria listed in the following paragraphs.

DC4-002 STORMWATER MANAGEMENT PLAN. All preliminary plats and development plans submitted for approval to the City of Gardner must be accompanied by a Stormwater Management Plan. The Stormwater Management Plan must provide analyses and design for storm drainage facilities in accordance with the criteria as hereinafter described.

DC4-003 MINIMUM DRAINAGE REQUIREMENTS. A minimum of 2 percent grade is required for positive drainage for all lot-to-lot developments. Due to the relatively flat topography in the City of Gardner, inlets shall be placed in subdivisions every 4 lots or less as needed, as determined by the City Engineer. Runoff from adjacent upstream properties shall be directed into swales or inlets as directed by the City Engineer.

DC4-004 MINIMUM STANDARDS OF DESIGN. Storm water runoff shall be carried by enclosed systems or open channels on the basis of criteria established in this section and APWA 5600 subject to the final determination and approval of the City Engineer.

Enclosed drainage systems shall be used to collect and convey drainage on, across and through public right-of-way. The enclosed system shall extend at least to the limits of the right-of-way and energy dissipating structures shall be provided as needed to prevent erosion damage.

Where enclosed storm drainage is located along side property lines, it shall remain enclosed to the rear property line or an existing channel at least forty (40) feet beyond the rear corner of the adjacent buildings.

Existing open channels may remain along the rear or side of properties when the design provides adequate protection to the adjacent property. Such protection shall be through the provision of a 100-year floodplain setback and the stream buffers specified in Section DC4-007. Regardless of the stream or stream corridor size, buildings must maintain a minimum distance of 40 feet from the ordinary high water mark of a stream. Side slopes for open channels shall not be steeper than 3 horizontal to 1 vertical (3:1) for turf lining; however, 4:1 side slopes should be achieved when at all possible.

Pipes under streets shall not be allowed to daylight within the “Clear Zone” of the street, as defined in the AASHTO “Roadside Design Guide” unless waived by the City Engineer. Such a waiver shall be requested in writing. When the requirement is waived, appropriate safety measures shall be applied.

A. Design Storm Frequencies. The minimum rainfall event to be utilized in determining the intensity of rainfall for storm flow calculations shall be based on the following:

Land Use/Zoning	Storm Return Frequency
Residential	10 Year
Commercial, Multi-Family	25 Year
Industrial	25 Year
Street Crossings	Per APWA 5600

B. Pipe Sizing. The minimum size storm sewer shall be fifteen (15) inches in diameter.

All storm drainage systems shall be designed so as to maintain a minimum velocity at the outlet of three feet (3') per second and a maximum velocity twenty feet (20') per second when flowing full.

C. Pipe Slope. Pipe with slopes greater than 10% shall be required to have concrete collars. The City Engineer will review spacing calculations from the design engineer for these conditions. Proof of proper abrasion resistance in pipe must also be provided.

D. Depth. All storm drainage lines shall have a minimum cover of eighteen inches (18").

E. Structures. The following minimum design standards shall be followed for stormwater structures, such as inlets, junction boxes, etc.:

- The minimum inlet or junction box size shall be 4 feet by 4 feet.
- The minimum distance from inner wall of the inlet or junction box to outside of pipe shall be 6 inches.
- All inlets shall be constructed outside of the curb radii.
- Driveways must be constructed a minimum of 2 feet from the flare of curb inlets.
- Grate inlets are not allowed unless approved by the City Engineer.
- Deflections in pipe shall not be allowed between structures.
- Any inlet, yard inlet, or junction box over 10 feet in length, 8 feet in width, or 12 feet in depth shall be considered non-standard and a detail provided designed and sealed by a structural engineer.

DC4-005 EASEMENTS. Permanent drainage easements shall be a minimum of fifteen feet (15') for enclosed structures or the outside width of the pipe or conveyance structure plus 10 feet, whichever is greater. Easements shall be centered on the pipe.

The City Engineer may require wider easements when other utilities are located within the same easement and/or when the depth of cover is greater than 4 feet.

DC4-006 STORMWATER DETENTION. Runoff from all developments shall be controlled by limiting the proposed stormwater release rate for the one percent (1%), ten percent (10%) and one hundred percent (100%) storm to the predevelopment peak flow rates for the 1%, 10% and 100% storm, respectively. If there are no existing flooding problems and flooding problems will not occur as a result of the proposed development as documented by a Stormwater Management Plan approved by the City Engineer, matching the proposed stormwater release rate to the predevelopment release rate for the 1% storm will not be required.

Per APWA 5600, to identify existing local flooding problems, the Stormwater Management Plan for a development project shall include an analysis of the existing downstream drainage system to the point the development's land mass is less than 10% of the total watershed. The City Engineer may require additional analysis of the downstream drainage system to identify flooding problems, especially in sensitive areas or where flooding has occurred downstream.

Stormwater detention requirements may be waived for infill sites if approved by the City Engineer. Prior to approval of a waiver, a Stormwater Management Plan shall be submitted to and approved by the City Engineer.

Stormwater detention shall be designed in accordance with APWA 5600 Section 5608. The basin shall be an amenity to the development with an aesthetic configuration and landscaping. Per APWA 5600, the water surface of the detention basin shall be a minimum of 20 feet from property lines and building structures. A greater distance may be necessary when the detention facility might compromise foundations or slope stability is a consideration.

DC4-007 STREAM BUFFERS. The City of Gardner has adopted the stream buffer requirements set forth in APWA 5600 Section 5605 as modified below.

Contributing Drainage Basin Size (Acres)	**Buffer Width From OHM*Outwards**
40 Acres To 160 Acres	60 Feet
160 Acres To 5,000 Acres	100 Feet
Greater Than 5,000 Acres	120 Feet

*OHM=Ordinary High Water Mark as defined in APWA 5600.

If the floodplain is mapped by the Johnson County Stormwater Management Plan, then the buffer width as shown by Johnson County will govern. If the floodplain is within the bank of the channel, an additional twenty-five feet (25') of buffer will be required from the top of bank in order to prevent development on the bank and subsequent erosion.

As stated in APWA 5600, no fill or grading activities shall be placed within the designated buffer zone.

DC4-008 DEVELOPMENT ACTIVITIES UNDER STATE AND FEDERAL JURISDICTION.

It is the responsibility of the design engineer to determine whether development activities fall under state or federal jurisdiction and to obtain applicable state or federal permits. Activities classified as a levee or floodplain fill project, channel change project, or dam or stream obstruction project can be subject to state jurisdiction requiring a permit. These activities are covered by K.S.A. 24-126 and K.S.A. 82a-301 to 305a. Projects in all three categories are also subject to environmental coordination review as required by K.S.A. 82a-325 to 327.

To obtain state and federal permits, plans and applications must first be submitted to the City of Gardner for review for general conformance to city standards. They will then be forwarded by the city to the appropriate division for state review and approval. The City of Gardner cannot approve plans for construction that are under state or federal jurisdiction until a state or federal permit is obtained.

DESIGN CRITERIA FOR

WATER LINE CONSTRUCTION

DC5-001 GENERAL. Proposed extensions of the water distribution system shall, in general, follow the pattern of constructing 12-inch water lines along all section lines and 8-inch water lines along all half-section lines. Deviations from this general policy may be deemed necessary by the city engineer should the provision of adequate service to prospective customers or fire protection needs, existing or anticipated, in the area to be served warrant said deviations.

Hydraulic calculations shall be submitted for review with all commercial and industrial plan reviews. Upon request by the City Engineer, hydraulic calculations shall be submitted for review with residential plan reviews.

All commercial and industrial waterlines shall be designed with a minimum of two feed lines (looped system) as determined by the City Engineer. Dead end lines will not be allowed without approval from the City Engineer.

No public water line shall be constructed less than 6 inches in diameter.

DC5-002 LOCATION OF WATER MAINS AND APPURTENANCES. Proposed water mains shall be located within street right-of-way to provide the least interference with the location of other utility lines. Street grades and elevations of proposed main shall be taken into consideration so that once constructed they will not require regrading or relocation.

In residential areas, the water main shall be located 1’ outside the right-of-way within the utility easement.

DC5-003 DEPTH. All water mains shall have a minimum cover of 42 inches (42”).

DC5-004 MATERIALS OF CONSTRUCTION. Polyvinyl chloride (PVC) or ductile iron pipe shall be used for all mains constructed in the City of Gardner.

The PVC pipe shall conform to ASTM D1784, ANSI/AWWA C900. Pipe wall thickness shall be DR-18 for pressure class 150 or DR-14 for pressure class 200.

The ductile iron shall conform to ANSI A21.51; ASTM A536, Grade 60-42-10; AWWA C151. The minimum nominal thickness class for ductile iron pipe shall be 50, unless otherwise designated by the City Engineer. All water mains shall be polyethylene encased and shall conform to ASTM A674.

DC5-005 FIRE HYDRANTS. Fire hydrants shall conform to AWWA C502, and shall be Mueller "Centurion" A-423, Waterous "Pacer" 100, American Darling B-84-B "Quik-Fix," or Kennedy Guardian.

Hydrants shall be traffic models with breakaway flanges and shall have one 4-1/2 inch pumper nozzle and two 2-1/2 inch nozzles. All hydrants shall be furnished with auxiliary gate valves.

Hydrants should be placed at or near street intersections, and at the end of permanent dead end lines (including cul-de-sacs), and at intermediate points when block lengths become long. Under no circumstances shall the spacing of fire hydrants exceed 400 feet in residential areas or 300 feet in commercial areas. Fire hydrant spacing in industrial areas shall be determined by the design engineer and approved by the Codes Administrator.

Fire hydrant installations shall conform to Standard Detail 50-2.

DC5-006 LINE VALVES. Gate valves shall be of the resilient-seated configuration and shall conform to the applicable requirements of AWWA C509.

Resilient-seat gate valves shall be American-80 "CRS" or Mueller A-2370-20 or approved equal.

Gate valves shall be used in all water mains 16-inches (16”) in diameter and smaller.

Butterfly valves shall conform to AWWA C504 and shall be Kennedy 50C, American C-1508, Mueller "Line Seal III", or approved equal. Butterfly valves shall be used in mains larger than 16-inches (16”) in diameter or where otherwise approved by the city engineer.

Valves shall be placed in all straight runs of pipe at intervals not to exceed 800 feet. Where two lines intersect, a valve should be placed in each pipe on each side of the intersection. Valves should be so placed that any pipe two (2) blocks long can be cut out of the general circulation without interrupting service in the rest of the system. All valves and meters shall be located outside of pavement and proposed and future sidewalks.

DC5-007 CONNECTIONS TO EXISTING WATER MAINS. Connections to existing water mains shall be made in such a manner as to provide the least amount of interruption to water service. In the event closing of valves to make a connection will affect a customer who cannot be without service, provisions shall be made on the plans for a temporary service. Where possible, connections to existing mains shall be made using tapping sleeves and valves as approved in the technical specifications of the City of Gardner.

When connections are made to an existing system under normal conditions, the exposed pipe and fitting interiors shall be wetted with a 500 mg/L chlorine solution before closure. In emergency situations the exposed interiors of the pipe and fittings are to be swabbed with a 1% chlorine solution.

Wetting and or swabbing are not considered effective methods of disinfection when there is a potential for significant contamination of the main, i.e., sewage is detected in the trench during repairs.

DC5-008 PROVISIONS FOR FUTURE EXTENSIONS OF WATER MAINS. At the termination of all water mains or at locations as specified by the City Engineer, a fire hydrant in accordance with Standard Detail 50-2 of the Technical Specifications of the City of Gardner or flushing assembly shall be provided. However, flushing assemblies shall only be used on 6” lines. All lines with a diameter greater than 6” shall terminate with fire hydrant assemblies.

DC5-009 THRUST BLOCKING. All fittings shall be restrained joint unless approved by the City Engineer. All piping within the designed distance of fittings shall be restrained joint in accordance with Table 1. The engineer shall determine and the plans reflect the locations and distances required for the installation of restrained joint piping.

DC5-010 HIGHWAY AND RAILROAD CROSSINGS. All crossings of highways or railroads shall be made by boring or tunneling. Casing pipe shall be greater to or equal to the strength and integrity of the carrier pipe. The installation shall comply to all federal, state, and local regulations. The work shall be in conformity with all requirements and regulations and be under the control of the authority owning or having jurisdiction over and control of the right-of-way in each case.

TABLE 1
THRUST RESTRAINT FOR DUCTILE IRON AND PVC
MAINS AND FITTINGS
FAST GRIP GASKETS

THE THRUST RESTRAINT TABLES ARE BASED UPON THE FOLLOWING CRITERIA:

1. HORIZONTAL FITTINGS ONLY
2. TYPE NO. 2 LAYING CONDITIONS
   - FLAT BOTTOM TRENCH, BACKFILL LIGHTLY CONSOLIDATED TO CENTERLINE OF PIPE.
3. CLAY NO. 1 SOIL CONDITIONS
   - CLAY OF MEDIUM TO LOW PLASTICITY
4. ALL DUCTILE IRON MAINS TO BE POLYWRAPED
5. DEPTH OF COVER 3.5 FEET
6. DESIGN PRESSURE 180 PSI
7. SAFETY FACTOR OF 1.5 TIMES

PLEASE NOTE:

ANY TRENCH, SOIL DEPTH OR PRESSURE CONDITIONS WHICH DEVIATE FROM THE ABOVE LISTED CRITERIA SHOULD BE REVIEWED BY THE CITY ENGINEER FOR AN ALTERNATIVE SOLUTION.

TABLE OF PIPE FOOTAGES REQUIRED TO RESTRAIN FITTINGS BY SIZE					
RESTRAINT FOOTAGE IS FOR EACH SIDE OF FITTING					
FITTING	4"	6"	8"	12"	16"
11 1/4 BEND	5'	7'	9'	13'	17'
22 1/2 BEND	9'	13'	18'	26'	33'
45 BEND	20'	28'	37'	53'	70'
90 BEND	47'	68'	89'	129'	168'
DEAD END	37'	53'	70'	102'	134'

TABLE OF THRUST RESTRAINT FOR TEES					
(RESTRAINT IS ON THE BRANCH ONLY)					
BRANCH SIZE	4"	6"	8"	12"	16"
RESTRAINT LENGTH	37'	53'	70'	102'	134'

TABLE OF THRUST RESTRAINT FOR REDUCERS BY SIZE				
REDUCER-SMALL END	12"	8"	6"	4"
LARGE END				
16"	57'/75'	98'/188'	113'/285'	124'/450'
12"	-	54'/79'	74'/142'	88'/245'
8"	-	-	29'/38'	50'/95'
6"	-	-	-	27'/39'

Example: 16” x 12” reducer requires the following: 57’75’
Length of restrained joint piping for the large side of reducer 57 feet

NOTE: If the straight run of pipe on the small side of reducer exceeds 75 feet them no restrained joints are necessary.

DC5-011 STREET CROSSINGS. Open cutting of streets shall be allowed only where permitted by the City Engineer. At locations where open cutting is not permitted, the crossing shall be made by boring or tunneling. Crossings made by boring or tunneling shall require a casing pipe unless otherwise approved by the city engineer. All work and materials shall be in conformity with all requirements of the technical specifications of the City of Gardner. The diameter and length of the casing pipe to be used shall be as determined by the City Engineer. All casing shall be extended past the right-of-way.

All temporary surfacing shall consist of cold-mix asphalt at a minimum.

DC5-012 BORINGS WITHOUT CASING PIPE Borings without casing pipe is used only with the recommendation of the design engineer and approval of the City Engineer. The bore size shall conform to the following table.

Pipe Size	O.D.	Push-On Joint	Bore Size
6" D.I.P.	6.0	9.13	14"
8" D.I.P.	9.05	11.50	16"
10" D.I.P.	11.10	13.63	18"
12" D.I.P.	13.20	15.75	20"

Sand shall be blown into the bore hole to fill the remaining voids.

DC5-013 FIRE FLOW REQUIREMENTS. The design engineer shall determine the amount of water that is required for fire protection based on I.S.O. guidelines for all waterline projects serving development sites other than single family. The City will assist with on-site flow tests if requested by the design engineer. The design engineer shall calculate the flow requirement and then determine if the existing and proposed waterlines can provide this flow based on existing operating conditions. Calculations verifying that the required flows can be met shall accompany the drawings when submitted for approval. Fire flow requirements will be reviewed by the Codes Administrator.

DC5-014 END OF CUL-DE-SAC. All cul-de-sacs shall be designed in conformance with Technical Specification 5030.

DC5-015 EASEMENTS. Permanent easements must be provided for all water mains. Permanent easements shall be centered on the main. The minimum easement width shall be 10 feet; however, easement widths may be increased depending upon the size of the water main.

DC5-016 MINIMUM SEPARATION FROM OTHER UTILITIES. Water mains in proximity to sanitary sewer mains must meet the minimum horizontal and vertical separation requirements stated in the City of Gardner's Design Criteria for Sanitary Sewer and Appurtenances (DC2). A minimum horizontal separation of 5 feet shall be provided between the outer wall of water mains and all other utilities. The separation between the outside walls of water mains and all other utilities that are within 10 feet of each other

must be labeled on the plans. The utilities shall not be placed in a common trench. In addition, the utilities shall be separated by a minimum of 3' of undisturbed soil.

REQUIREMENTS FOR

PUBLIC IMPROVEMENT PROJECT PLAN PREPARATION

DC6-001 INTRODUCTION. The following criteria is established to provide a uniform system of plan preparation that will aid the engineer in preparing plans for work within the City of Gardner.

DC6-002 GENERAL. All plans and specifications for public improvement construction shall be sealed by a professional engineer licensed in the state of Kansas and submitted to the office of the City Engineer for review. Subsequent to the review, the engineer will be notified of the approval of the plans as submitted, or of any necessary changes. (Refer to the section "Public Improvement Project Plan Submittal" for plan review procedures.)

Upon completion of the review and approval of the plans by the City Engineer, 5 sets of full size plan sets, 1 set of half size plan sets, 1 copy of the electric layout sheet, and 1 electronic copy of the plans in Autocadd must be submitted for signing and distribution.

The suggested plan sheet size is 22" x 36" or 24" x 36" with all sheets in a given set of plans being of the same size. Plan and profile shall be drawn on double or single plan and profile sheets to scales of one inch (1”) equals fifty feet (50’) horizontal by one inch (1”) equals ten feet (10’) vertical, unless otherwise approved by the city engineer for special cases.

The plans shall consist of:

1. Title Sheet
2. General Layout Sheet
3. Grading and Erosion Control Sheet
4. Electric Layout Sheet
5. Drainage Basin Map Sheet
6. Plan and Profile Sheets
7. Intersection Detail Sheets
8. Cross Section Sheets (Street Improvement Plans only unless otherwise required by the City Engineer.)
9. Standard Detail Sheets
10. Pavement Marking and Signage Sheet (as necessary)
11. Traffic Control Plan (as necessary)

Each sheet should contain a sheet number, including the individual sheet number and the total number of sheets, the engineer's seal, proper project identification and date.

DC6-003 TITLE SHEET. The following items shall be included on the title sheet:

1. Name of project or subdivision.
2. City project number (if applicable).
3. Section, ¼ Section, Township, and Range.
4. Index of sheets included in plans.

5. Summary of quantities table (may be included on this sheet or general layout sheet).
6. A vicinity map adequately showing project location in relation to major streets.
7. A summary of plan quantities of principal items, such as:
    - Pipe sizes, number of manholes, etc. (sanitary sewers)
    - Length of curb and gutter, square yardage or tonnage of asphaltic concrete pavement, etc. (streets)
    - Pipe sizes, number of inlets, etc. (storm sewers)
    - Pipe sizes and lengths, number of valves, etc. (water lines)
8. The project control bench mark (Permanent benchmark shall be a Johnson County Vertical Control Network Benchmark).
9. Name, address and telephone number of the consulting engineer and owner/developer.
10. List containing name and telephone number of each utility company.
11. Project design speed.
12. City Engineer's signature line.
13. Signature and stamp of Professional Engineer registered in the state of Kansas.

DC6-004 GENERAL LAYOUT SHEET. The following items shall be included on the general layout sheet for all improvement projects:

1. A legend of symbols shall be shown which shall apply to all sheets.
2. North arrow and scale. Scale of the general layout map shall be one inch (1") equals 100 feet (100'), unless otherwise approved.
3. Layout shall include names of subdivision, block designation, if any, lot designation, or proposed block and lots, all street names, and an accurate tie to at least one quarter section corner. An unplatted tract shall have an accurate tie to at least one quarter section corner.
4. Lot lines, subdivisions, buildings within 200' of the proposed facility (screened to 65%).
5. Boundary line of project area.
6. A list of general notes to the contractor to include at least those notes indicated in the "Procedure For Public Improvement Project Plan Submittal" section of this manual.
7. General layout of all utilities and easements.

DC6-005 GRADING AND EROSION CONTROL SHEET. The grading and erosion control sheet shall be drawn at a scale of 1"= max 100' (1"=20', 1"=50', or 1"=100' are acceptable) with match lines for multiple sheets when necessary. The following items shall be included on the grading and erosion control sheet:

1. Existing topographic features – trees, hedges, brush, buildings, pavement, utilities, fences, curbs, drives, sidewalks, inlets, manholes, valves, and other manmade objects - shown in ½ tone.
2. The current physical features (both natural and manmade) of the property and adjacent land within 50', including contours at vertical intervals of not more than 5' where the slope is greater than 10% and not more than 2' where the slope is less than 10%.
3. Proposed contours shown at the same contour interval as the existing contours.
4. Lot and subdivision lines with lots and blocks numbered per the plat of the subject subdivision.

5. Street centerline alignment with edge of pavement lines, edge of sidewalk lines, and back of curb lines.
6. North arrow and bar scale.
7. Street names, R/W lines, existing and proposed easements (show centerline and limits of the easements).
8. 2% minimum grading is required for positive drainage.
9. 100-year floodplain and stream buffers (if applicable).
10. Appropriate erosion control measures and applicable notes (may be shown on separate sheet).
11. The consultant shall also submit a copy of the application for an NPDES permit.
12. Limits of construction.

DC6-006 ELECTRIC LAYOUT SHEET. For subdivision plans, the Electric Division for the City of Gardner will provide the design engineer with a schematic of the electric and street lighting layout to be included in the plans. The plans shall include street crossings, proposed street lighting layout, proposed conduit, and proposed layout of feedthrough cabinets, transformers, etc. This sheet will be used by the Electric Division to install the electric infrastructure once plans are approved.

DC6-007 DRAINAGE BASIN MAP SHEET. The drainage basin map sheet shall be drawn to such a scale as to fit on one sheet where possible, but shall not exceed 1"=1000', and shall include the following information:

1. A plan view of the project.
2. A layout of all pipe systems with the structures numbered.
3. Boundaries of all basins (there should be a sub-basin for each inlet) shall be shown, and each basin and sub-basin shall be labeled.
4. A data table providing stormwater calculations (K, C, I, Q, Q_{total}, t_c, HGL, etc.) and pipe data (length, slope, diameter, full pipe velocity, etc.). The data table should also include 100-year calculations for emergency overflows.

DC6-008 PLAN AND PROFILE SHEETS. The following items shall be included on the plan and profile sheets for all improvement projects:

1. North arrows and scale.
2. Elevation and location of all applicable bench marks (Permanent benchmark shall be a Johnson County Vertical Control Network Benchmark).
3. Existing and proposed streets with names and widths.
   Construction limits.
4. Property lines properly identified as to existing or proposed lot, block and subdivision.
5. All existing and proposed utilities such as power, gas, oil, water, telephone, sewer, and other items shall be properly located in conformance with the best information available in the records of the owner of such facilities, or field location, and identified as to size, material, and type of construction.
6. All existing and known proposed improvements within 75 feet each side of center line shall be shown at their proper locations. This shall include such existing items as paved streets, curbs and gutters, driveways, culverts, fire hydrants, utility poles, trees, shrubs, fences, walls, houses, and other such items, and shall be identified as to

type, size, material, etc., as may be applicable. In case of new developments, some irrelevant items may be omitted.

7. All existing easement and right-of-way information recorded with the county.
8. Minor construction notes shall appear on the proper plan and profile sheets.
9. Locations and widths of existing and proposed sidewalks.

In addition, the following items shall be included on the plan and profile sheets for the particular type of improvement stated below.

STREETS.

1. Horizontal curve data, vertical curve data, stopping sight distances and design speed.
2. Gradient between vertical curves.
3. Center line stations.
4. Cul-de-sac and island radii.
5. Proposed drainage structures numbered and/or labeled.
6. Stations and grade at curb returns (at 1/4 points).
7. Profile shall show existing grade above center line as a dashed line, proposed finish grades or established street grades by solid lines.
8. Location of monument boxes.

STORM DRAINAGE.

1. Detailed alignment of the storm sewer, appurtenances, sizes of line, capacity, and other details relating to the storm drainage system including inlet station and top and invert elevations.
2. Proper ties into existing permanent facilities.
3. Distances between the storm sewer and other existing or future utilities in the right-of-way or drainage easement.
4. Drainage channel, slope and cross sections.
5. Existing and proposed street grades.
6. Proper elevations, slopes and lining for existing outfall ditches.
7. Energy dissipation at outlets (if rip rap is specified, label length, width, thickness, and stone size).
8. Locations of all bends and appurtenances.
9. Show size, slope and gauge (class) of each line on the profile.
10. Location, cross-section, capacity of, overflow swales. Show velocity in swale and erosion protection where necessary.
11. All utility crossings shall be shown on the profile view with approximate elevations given.

SANITARY SEWER.

1. Detailed alignment of the proposed sewer with the manhole designation, either by station and angle shown at each manhole or dimensioned ties to property lines at reasonable frequent control points to provide unquestionable locations of the sewer within street right-of-way or on private property.
2. The channel center line of waterways within 50 feet either side of center line of sewer shall be shown.
3. All manholes shall be shown with manhole designation station and invert elevations. Drop manholes shall be designated as such. Invert elevations shown shall be the invert of the pipe in and out of the manhole. Proposed finish grade

elevation of top of manhole shall be shown. Distance between manholes shall be shown as well as the gradient, pipe size, and type of material.

4. Results of all rock borings shall be shown at the proper locations.
5. Accurate elevations of either the first-floor surface or the basement floor surface shall be shown, and identified, for all existing and/or proposed structures for all building sites to be served by the proposed sewer system.
6. A uniform system of line and manhole designation shall be used subject to the approval of the City Engineer's office.
7. Station, slope and length of each stubline.
8. Profile shall show existing grade above center line as a solid line, proposed finish grades or established street grades by dashed lines, and shall show the flow line of any drainage channel, either improved or unimproved, within 50 feet either side of center line. Each line shall be properly identified. The proposed sewer shall be shown as double solid lines properly showing the height of the pipe.
9. All utility crossings shall be shown on the profile view with approximate elevations given.

WATER LINES.

1. Alignment of the proposed water line dimensioned from curb lines or right-of-way lines.
2. Designation by station of all fire hydrants and line valves.
3. Results of all rock borings shall be shown at the proper locations.
4. All utility crossings shall be shown on the profile view with approximate elevations given.

DC6-009 INTERSECTION DETAIL SHEETS. The intersection detail sheets shall show the intersections at 1"=20' or 1"=10'. The following items shall be included on the intersection detail sheets:

1. North arrow and bar scale.
2. Back of curb and face of curb lines and edge of pavement line.
3. Radius line for curb returns with length of radius labeled.
4. Storm inlets, manholes, other proposed items.
5. Plus station for start/stop of tapers, turn lanes, curb returns—with offsets where appropriate.
6. Top of curb elevations and stations every 25' with plus station, elevations and offsets at curb returns and at midpoint of curb returns.
7. Horizontal alignment data (same as Plan and Profiles).
8. Location of sidewalks, handicap ramps, with dimensions for sidewalks.
9. Street lighting poles, etc.

DC6-010 CROSS-SECTION SHEETS. The following items shall be included on the cross-section sheets:

1. Street cross-section at each station showing existing grade by dashed lines and proposed grade by a solid line. Cross-sections to show existing grade lines a minimum of 10 feet beyond right-of-way lines. Show cut and/or fill quantities at each cross-section.
2. Center line elevation of top of pavement.

3. Cross-sections shall be shown at all intersecting streets and driveways.
4. Channel cross-sections shall be shown for all drainage channel improvements.
5. Additional cross-sections shall be shown as required to clearly describe the extent of the grading operations.

DC6-011 PAVEMENT MARKING AND SIGNAGE SHEET. The pavement marking and signage sheet shall be typically drawn to scale at 1"=50'. The following items shall be included on the pavement marking and signage sheet:

1. North arrow and bar scale.
2. Legend.
3. Existing topographic features – trees, hedges, brush, buildings, pavement, utilities, fences, curbs, drives, sidewalks, inlets, manholes, valves, and other man-made objects—screened to 65%.
4. Horizontal alignment of the proposed streets, including centerline and stationing.
5. Proposed drainage structures and other proposed structures.
6. Proposed edges of pavement and sidewalk, and back of curb lines.
7. Station equation at all proposed intersections (including an intersection of a proposed street with an existing street).
8. Street names.
9. Proposed and existing right-of-way.
10. Construction limits.
11. Easements of all types, existing and proposed.
12. Proposed and existing street light poles.
13. Stationing of all proposed pavement markings.
14. Lane width dimensions.
15. Stationing and MUTCD number for all proposed signs.
16. General Notes that include but are not limited to:
    - All markings shall be in accordance with the latest edition of the MUTCD.
    - All existing markings that conflict with the proposed markings shall be completely removed.
    - The contractor shall maintain ALL existing signs not shown on the plans as to be removed.

DC6-012 TRAFFIC CONTROL PLAN SHEET. The traffic control plan sheet shall be provided as necessary. This plan shall be prepared by a certified traffic control consultant and shall be reviewed and approved by the City Engineer. The traffic control plan sheet shall include construction sequencing and overall phasing plan, work areas identified y shading and/or line patterns, construction notes describing each phase of construction, a detour plan (if applicable), etc.

DC6-013 STANDARD DETAIL SHEETS. Detail sheets shall be included to show all details of appurtenances, materials, and construction whether or not covered by the Gardner, Kansas, standards. Details shall conform to the City of Gardner standards and are to be drawn clearly and neatly with proper identifications, dimensions, materials, and other information necessary to ensure the desired construction.

DC6-014 CONSTRUCTION RECORD DRAWINGS. Construction record drawings for all public infrastructure shall be submitted to the City Engineer upon completion of the project and

prior to final acceptance of the project by the City of Gardner. The design engineer shall provide the city with two (2) sets of prints for all public improvement projects corrected to show the project as constructed and shall accurately and completely denote all changes made during the course of the work. Each sheet within the plans shall be clearly marked as "Conforming to Construction Records" and shall include the date of revision and certifications by the engineer.

PRIVATE IMPROVEMENT

DESIGN CRITERIA

DC7-001 GENERAL Private improvement construction in the City of Gardner shall in all respects be designed to conform to applicable codes, regulations and ordinances as established by the City of Gardner. Plans for private improvements being made in conjunction with building construction shall be submitted through the Community Development Department. All street, roadway, driveway, and sidewalk construction, public or private, shall conform to the technical specifications and design criteria for public improvements as stipulated herein.

Private improvements that are not being constructed in conjunction with new building construction or an addition to an existing building shall submit plans to the Engineering Department for review and approval. Improvements for water line, sanitary sewer line, storm sewer line and street construction shall conform to the design criteria of the City of Gardner and/or the applicable sections of the adopted building codes.

DC7-002 PARKING LOT CONSTRUCTION Parking lot construction shall conform to the following design criteria and shall abide by all City of Gardner ordinances.

A. Materials for Construction. The following materials are acceptable for parking lot construction in the City of Gardner:

1. Pavement. The pavement cross-section shall consist of full depth asphaltic concrete (minimum of four inches) over a crushed rock base (minimum of six inches), or portland cement concrete pavement (minimum of five inches) with 10 gauge welded wire mesh on six (6) inch centers each way embedded two (2) inches from the bottom surface of the slab.

2. Driveway Entrances and Curbing Within Public Right-of-Way. These items shall meet the requirements of Section 1400, 2000, and 2100 of the Technical Specifications of the City of Gardner. They will be constructed of Class II air-entrained concrete.

3. Curbing. Parking lot curb shall be of 4000 psi air-entrained concrete.

B. Curb and Curb and Gutter. Concrete curbing shall be provided along the perimeter of parking areas and along drives connecting parking areas with public streets. Curbing shall have a six-inch vertical face above the surface of the pavement. Curbs shall be constructed as cast-in-place. In areas of the lot adjacent to proposed future expansion, asphaltic concrete curb may be used if approved by the City Engineer. The proposed future expansion shall be shown on the plans.

All work within public right-of-way shall conform to applicable City of Gardner standards. Driveway approaches shall be constructed with integral curb and gutter conforming to City of Gardner Type "B" curb and gutter. Transition to existing curb and gutter shall be made at saw joints in existing curb or at existing expansion joints. Construction and expansion joints, dimensions, elevations and surface finish shall match as closely as possible to that of existing adjacent curb and gutter. Expansion joints shall be placed where new curbing abuts existing curbing.

C. Drainage Facilities. All parking areas shall be provided with adequate drainage facilities as approved by the City Engineer. Enclosed storm sewers shall be used to collect and convey drainage on, across and through public right-of-way. All effort will be made, within the limits of the existing topography, to prevent stormwater runoff from parking lots from exiting through driveway entrances. If the design engineer can justify the need for stormwater to exit through a drive entrance, the maximum flow of water allowed shall be governed by the design criteria for storm drainage facilities for the City of Gardner and APWA 5600. If the flow is in excess of the gutter capacity then it must all be picked up by a curb inlet prior to entering public right-of-way.

A Stormwater Management Plan shall be submitted to the City Engineer for review and approval in accordance with the Design Criteria for Storm Drainage Facilities of the City of Gardner. Drainage structures located in the public right-of-way used and constructed as a portion of the storm drainage facilities for parking lots shall be in accordance with the Technical Specifications of the City of Gardner.

D. Driveway Entrances. All commercial driveway entrances constructed within the public right-of-way shall be constructed of concrete with a minimum thickness of seven inches (7") (see detail in Section 2100). Each commercial or industrial property shall be allowed at least one driveway approach but may have more as long as the total maximum summation of the widths of all driveway approaches upon the property does not exceed 20 percent (20%) of the length of the real property that fronts the abutting city street subject to approval by the City Engineer. Should more than one driveway approach be desired, there shall not be less than 90 feet between the center lines of each driveway approach. Final layout of driveway approaches is subject to approval by the City Engineer. In addition to the above, the following dimensions shall govern construction of driveway approaches:

1. Width of Driveway Approach

    a Commercial Driveway Approach - The width of commercial driveway approaches shall not exceed 35 feet or be less than 25 feet measured parallel to the center line of the street at the property lines for two-way driveway approaches; provided, however, that commercial property may be allowed to have a driveway approach not exceeding 52 feet, if said driveway approach does not exceed 20 percent of the length of the real property abutting the adjacent city street and a four foot raised median is placed within such driveway approach to divide the entrance and exit lane(s). The minimum width of a one-way driveway shall be 20 feet.

b Industrial Driveway Approach. The width of industrial driveway approaches shall not exceed 65 feet or be less than 25 feet measured parallel to the center line of the street at the property lines for two-way approaches; provided that the minimum width for a one-way driveway shall be 16 feet.

2. Corner of Adjacent Property Line Offset.

Commercial or Industrial Driveway Approaches. When commercial or industrial driveway approaches are located at or near a street intersection, in no case shall the distance from the property corner at the intersection be less than 75 feet to the near line of the nearest driveway approach, as extended to the street curb or pavement edge.

No commercial of industrial driveway approach shall be constructed having a tangent length between the curb return and the property line extended, of less than 12-1/2 feet.

3. Driveway Offset. Either center lines of opposing driveways shall align, or shall be offset no less than 75 feet. This condition shall not apply where a permanent median exists without break for these driveways.

4. Turning Radii.

a Commercial Driveways. Commercial driveway approaches shall have a minimum radii of 15 feet.

b Industrial Driveways. Industrial driveway approaches shall have a minimum radii of 25 feet. When a private improvement is determined to serve trucks with longer wheelbases, the city engineer may require a greater minimum radii for driveway approaches.

c. Common Driveways. Driveways that are shared by adjacent property owners require that a common driveway (ingress/egress) easement be filed and on record at the County Register of Deeds office.

E. Construction on Public Right-of-Way Under State Jurisdiction or Control. All construction within right-of-way under the control or jurisdiction of the state of Kansas shall be reviewed and approved by the appropriate state agency prior to submittal of the plans to the City of Gardner. Plans submitted to the City of Gardner for review shall reflect all changes or corrections as required by that state agency and also outlined on the approved state permit.

PRIVATE IMPROVEMENT

PLAN PREPARATION

DC8-001 INTRODUCTION. The following criteria is being established to provide a uniform system of plan preparation for work within the City of Gardner related to private improvements.

DC8-002 GENERAL. All plans for private improvements shall be prepared by a professional engineer licensed in the state of Kansas and submitted to the Engineering Department for review. Subsequent to the review, the engineer will be notified of the approval of the plans as submitted, or of any necessary changes.

Private improvements plans that involve water lines, sanitary sewer lines, storm sewer lines, or street construction shall be prepared in accordance with the plan preparation requirements detailed in Section 7 of the Design Criteria.

Private improvements involving parking lot construction shall meet the requirements outlined in Section 7 of the Design Criteria.

DC8-003 PARKING LOT PLANS. The following items shall be contained on the plans submitted for review for the construction of a new parking lot or an addition to and existing parking lot.

A. A location map, with north arrow, adequately showing project location in relation to major streets.

B. General site layout to include:

- Building location (if applicable),
- Street names, lot and block designation, and
- An accurate tie to at least one quarter section corner. Unplatted tracts shall have an accurate tie to at least one quarter section corner.

All existing property lines, lot lines, street right-of-way lines and temporary and permanent easement lines shall be shown at their proper location. Street right-of-way lines and existing driveways shall be shown on both sides of the street that falls on the perimeter of the lot.

All existing and proposed utilities such of electric, gas, oil, water, telephone, sanitary sewer, storm sewer, and other applicable items located in conformance with the best information available in the records of the owner of such facilities, or field location, and identified as to size, material and type of construction.

C. Include existing and proposed site contours for the site. Supplement the proposed contours with spot elevations at critical locations.

D. Show limits of paving and perimeter curbing. Indicate the location of parking stalls, including handicapped parking, and show all dimensions, radii and other significant geometric details.

E. The plans shall include a legend for the site layout detail and a sheet of standard details. The standard details shall include a profile view of the proposed curb(s), a section through the proposed pavement detailing pavement composition, a driveway entrance detail (use the City detail from Section 2100 if the entrance is from a public street), proposed drainage structures, and any other appropriate details as may be required for clarity or by request of the City Engineer.

F. Storm drainage facilities shall be shown in both plan and profile view. These views shall show inlet and pipe locations, size, material, gage, slope of pipe, and all invert and top of structure elevations. Include on the plan sheets a drainage calculation summary table containing information on: pipe size and slope, pipe capacity, velocities, time of concentration, runoff coefficient, incremental and accumulated tributary acreage, rainfall intensity, and the total rainfall runoff.

G. General construction notes as required.

MINIMUM GAUGE REQUIREMENT FOR CIRCULAR CMP CULVERT PIPE

DIAMETER (inches)	GAUGE		ANNULAR CORRUGATIONS (inches)
	Not under road	Under road	
15	16 ga.	16 ga.	2-2/3 x 1/2
18	16 ga.	16 ga.	2-2/3 x 1/2
21	16 ga.	16 ga.	2-2/3 x 1/2
24	16 ga.	16 ga.	2-2/3 x 1/2
30	16 ga.	14 ga.	2-2/3 x 1/2
36	16 ga.	14 ga.	2-2/3 x 1/2
42	16 ga.	14 ga.	3 x 1
48	16 ga.	14 ga.	3 x 1
54	16 ga.	14 ga.	3 x 1
60	16 ga.	14 ga.	3 x 1
66	16 ga.	14 ga.	3 x 1
72	16 ga.	14 ga.	3 x 1
78	14 ga.	14 ga.	3 x 1
84	14 ga.	12 ga.	3 x 1
90	14 ga.	12 ga.	3 x 1
96	14 ga.	12 ga.	3 x 1
102	12 ga.	12 ga.	3 x 1
108	12 ga.	12 ga.	3 x 1
114	12 ga.	12 ga.	3 x 1
120	12 ga.	12 ga.	3 x 1

MINIMUM GAUGE REQUIREMENT FOR
ARCH CMP CULVERT PIPE

EQUIVALENT ROUND DIAMETER (inches)	SPAN (inches)	RISE (inches)	GAUGE		ANNULAR CORRUGATIONS (inches)
			Not under road	Under road	
15	17	13	16 ga.	16 ga.	2-2/3 x 1/2
18	21	15	16 ga.	16 ga.	2-2/3 x 1/2
21	24	18	16 ga.	16 ga.	2-2/3 x 1/2
24	28	20	16 ga.	16 ga.	2-2/3 x 1/2
30	35	24	14 ga.	14 ga.	2-2/3 x 1/2
36	42	29	14 ga.	14 ga.	2-2/3 x 1/2
42	46	36	14 ga.	14 ga.	3 x 1
48	53	41	14 ga.	14 ga.	3 x 1
54	60	46	14 ga.	14 ga.	3 x 1
60	66	51	14 ga.	14 ga.	3 x 1
66	73	55	14 ga.	12 ga.	3 x 1
72	81	59	14 ga.	12 ga.	3 x 1
78	87	63	14 ga.	12 ga.	3 x 1
84	95	67	14 ga.	12 ga.	3 x 1
90	103	71	14 ga.	12 ga.	3 x 1
96	112	75	12 ga.	12 ga.	3 x 1
102	117	79	12 ga.	12 ga.	3 x 1
108	128	83	12 ga.	10 ga.	3 x 1
114	137	87	12 ga.	10 ga.	3 x 1
120	142	91	12 ga.	10 ga.	3 x 1

Span and rise dimensions are industry standards. However, span and rise dimensions can be varied within ASSHTO tolerances to allow additional cover at critical fill height installations.

It should be noted that when using arch culvert pipe, the designer should take into account the reduction in hydraulic capacity when compared to that of circular pipe.